Chapter Six:

Bridge Decks

Following the erection of the structural supports, the contractor can begin construction of the bridge deck. Inspecting bridge deck construction includes many of the same inspection concerns seen during earlier phases of the work. The major steps that will be discussed in this chapter are:

- Establishing grade control points;
- Installing deck forms and reinforcing steel;
- Adjusting the finishing machine screed rails; and
- Concrete placement, finishing and curing.

References

Many of the general requirements dealing with bridge deck construction are contained in Section 700 of the Standard Specifications under the heading "Structural Concrete." More specific requirements are outlined in Section 704, "Concrete Floor Slabs." Section Five of the Department's *General Instructions to Field Employees* contains valuable information on setting screeds.

Certified Technicians should also refer to the Department's series of Standard Drawings for bridges, and in the case of a specific project, they should become familiar with the superstructure detail sheets and any Special Provisions associated with that project.

Grade Control

Establishing accurate grade controls for a bridge deck is essential for both ride quality and structural integrity. Errors mean an uneven surface with too much concrete cover in one area, too little cover in another. Although most of the computation involved in establishing grade controls for bridges will be performed by the contractor, the technician must know how to interpret their findings to ensure producing a deck that has uniform thickness and provides adequate concrete cover over the reinforcing steel.

Screed Elevations

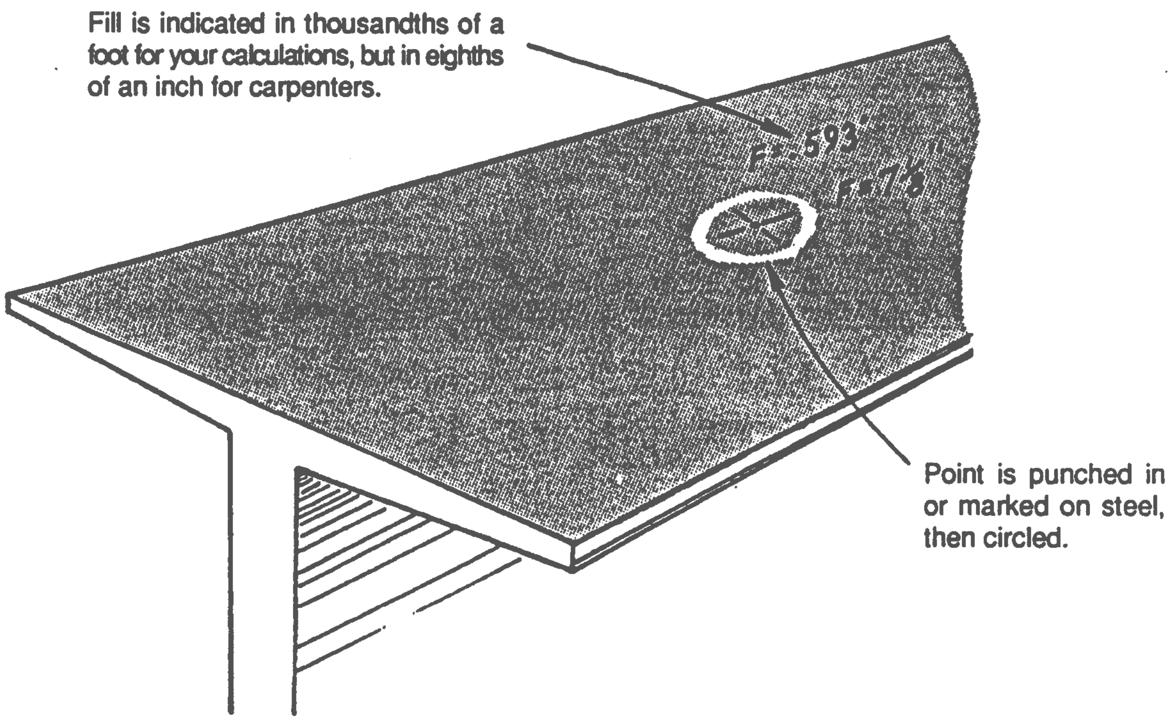
After the erection of the structural members and the tightening of all bolts, the contractor takes and records elevations at predetermined grade control points along *each girder of each span* in the structure. Averages cannot be used.

The grade control points are typically located at regular intervals on the members, such as every 10 feet or at some fraction of the span length such as every 1/8 point. The plans or the PE/PS will specify the intervals or locations of the grade control points. If the elevations are taken by the contractor, he must furnish a copy to the PE/PS.

The next step is to subtract these field elevations from the *theoretical screed elevations for* the same points as shown on the plans or furnished by the Department. The theoretical screed elevations take into account the planned deck thickness, the rate of cross-slope, and the amount of deflection that will occur at the control points when the concrete is placed. The planned deck thickness, cross-slope, and amount of deflection will be shown on the superstructure detail sheets in the plans.

The difference between the screed elevations and the field elevations at the control points equals the distance between the top of the beam and the top of the deck. In other words, the difference between the screed elevation and the field elevation equals the *slab thickness* at that point.

Refer to the illustration on the next page. The distance between the top of the beam and the screed elevation is typically marked on the top of the beam in inches and circled. The screed of the finishing machine will be set to pass above that point at the indicated distance. If the beams *or* girders have been accurately cambered and properly set, the slab thickness should equal the thickness specified on the plans. Variations from the planned thickness usually indicate deviations in the camber of the beam or girder. The contractor can make up for some minor deviations when he installs the deck forms.



Deck Forms

Forms for bridge decks support the concrete between adjacent structural members until it hardens sufficiently to stand on its own. To a large degree, the placement of the deck forms controls the slab thickness. Like formwork for substructure units, deck forms must be mortar tight and sufficiently rigid to support the concrete without distorting under the load.

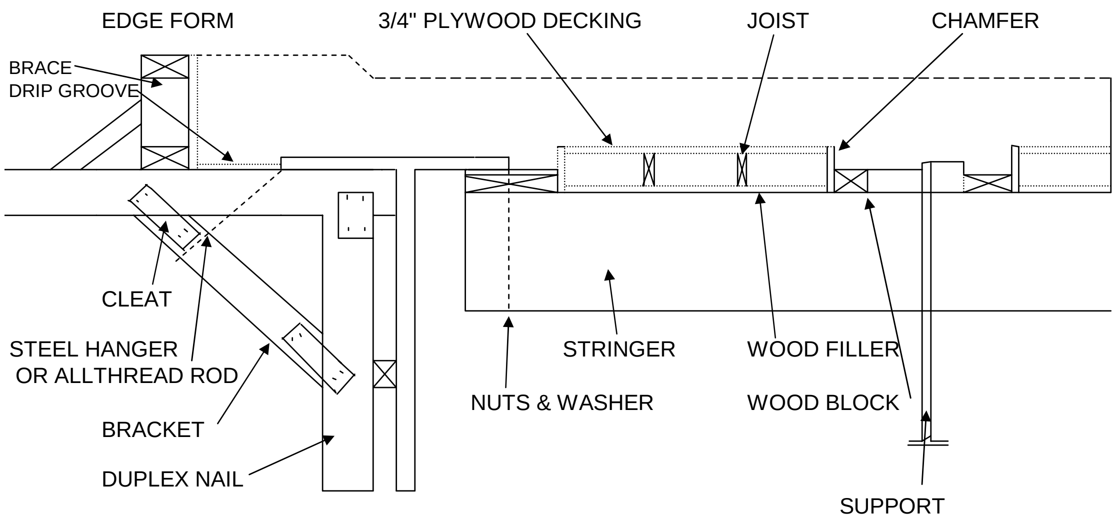
Approval of Falsework Plans

The contractor must submit falsework plans to the Department for approval. These plans show how the contractor plans to support the forms so that they produce the slab thickness and grades shown on the plans. Any falsework or forms installed before these plans are approved is done at the contractor's risk.

Types of Deck Forms

There are two types of deck forms: removable and permanent. Most removable forms are made of wood. Permanent forms are usually made of metal or prestressed concrete.

Removable wood forms typically consist of 3/4 inch exterior-grade plywood sheets for the flooring supported by wood joists and stringers and adjustable metal brackets and hangers. They're used with all types of structural members. Wood form materials do not require specific approval or certification, but the Certified Technician should make sure the materials are clean, straight, and in reasonably good shape. Joints should be filled to prevent concrete leakage. Form faces that will come into contact with concrete need to be coated with an approved lubricant so they'll be easy to remove and won't mar the concrete surface.



Permanent metal forms come in panels of corrugated steel. When steel beams or girders are used as structural members, the panels are supported by metal angles that are welded or strapped to the top flange. The form panels are not permitted to rest directly on the structural steel itself.

When prestressed concrete I-beams or box beams are used, permanent metal forms are supported by adjustable straps or hangers, or by steel inserts that have been cast into the top flange. No form support may be welded to the reinforcing steel extending from a concrete beam.

Another type of permanent deck form is precast, prestressed deck panels. These panels are usually placed on a joint filler support that has been glued to the top of a concrete beam. Deck panels have shear-connector hooks of #4 re-steel cast into the top surface to tie them into the concrete deck.

When precast, prestressed deck panels are used, the bottom layer of longitudinal deck may be unnecessary because the panels contain their own longitudinal reinforcement. Additional longitudinal reinforcement, however, may be required for the top mat. Bridge Standard 707-BPDP-01 to 05 contains specific information and drawings regarding the design and use of precast deck panels.

Installing Deck Forms

As far as the installation of the deck forms go, the technician has one primary concern: that the forms are installed in such a way that they produce the required slab thickness and cross-slope at every point along the surface of the deck. Of course, the contractor must follow the requirements of the contract drawings and the specifications, but the overall purpose behind the use of formwork is to provide a correct and uniformly consistent deck thickness.

The contractor installs the deck forms according to the figures marked at the grade points on top of the beams and the degree of cross-slope per foot as specified on the plans. For example, if the mark on the beam is 8 3/4" and the planned thickness of the slab is 8", the contractor knows the floor of the deck forms must be set 3/4" *higher* than the top of the beam. On the other hand, if the mark on the beam is 7 1/4", the forms would be set 3/4" *lower* than the top of the beam. When working away from the crown, the contractor should add into his calculations the degree of cross-slope; when working toward the crown, the cross-slope would be subtracted. Cross-slope can be maintained and checked for accuracy with a stringline or a level.

During the installation of metal deck forms, the technician should make sure that no support angles are welded onto flanges of steel beams or girders that are "in tension." On simple spans, the bottom flange is the tension flange; on continuous spans, the areas in tension change. The plans will show which areas are in tension and which are in compression for continuous spans.

To prevent loss of mortar through the joints, metal deck forms should be overlapped and installed in the opposite direction of the direction of the concrete pour. Panels should be secured as soon as they're placed to prevent them from being blown off by the wind.

Installation of Shear Connectors

Steel beams and girders will often have to have the shear connector studs welded to the top flange in the field. The size and spacing of the studs will be specified on the plans and may not be changed without the Engineer's approval. And again, because the installation requires welding, the Certified Technician needs to know what areas of the top flange on a continuous span will be in tension.

The installation of the shear connectors is fairly easy to inspect -- there are only three things to look for:

1. The site of the weld is clean and smooth;
2. The weld is made completely around the base of the stud; and
3. The studs are spaced according to the plans.

A number of the welded shear connectors should be tested by bending them to an angle of at least 15 degrees with a hammer. If the weld holds for the studs sampled, the remaining connectors on that beam can be accepted.

Deck Reinforcement

Inspecting deck reinforcement is no different from inspecting the re-steel for any other part of the structure. The main concerns are:

- The right sizes and types of bars are placed in the correct locations.
- *All* bars listed in the plans are used; no leftovers.
- The correct bar *spacing* is maintained.
- Bars are checked for proper amount of clearance from the deck forms and for proper amount of concrete cover.
- All bars are securely tied to prevent displacement; the top mat should be tied down to the bottom mat or the deck forms to prevent "floating" during the pour.
- Trussed sections of trussed bars are centered over beams
- All splices are correctly lapped.

To ensure the above points, the contractor should double check the accuracy of his deck form installation before placing the re-steel. Once the steel is in place, adjustments to the forms will be difficult and time consuming.

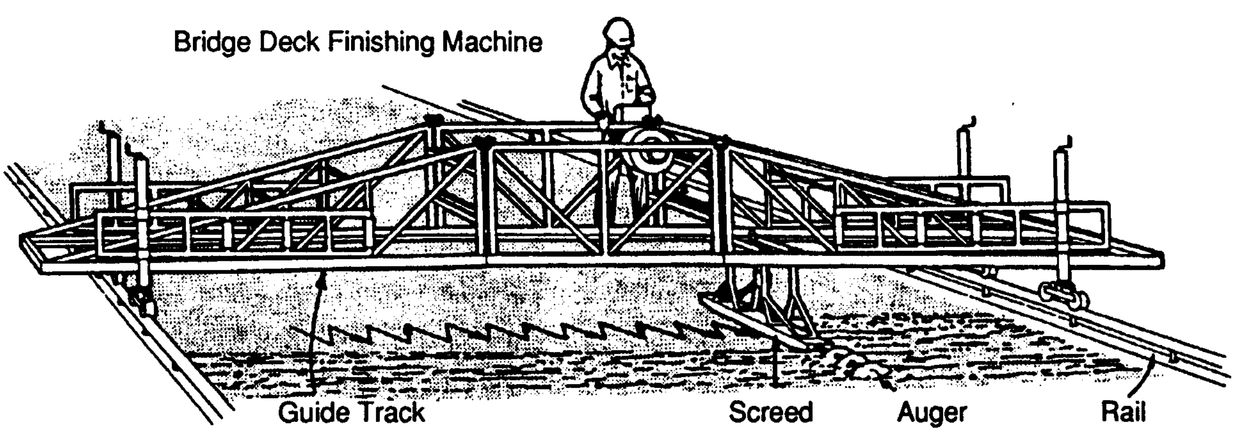
The technician should check the clearance between the bottom layer of re-steel and the deck forms. Typical clearance is one inch. Approved chairs may be used to obtain and maintain the clearance off the forms.

The technician should also check the positions of expansion joints and drainage features. These too must be correctly placed in terms of the planned slab thickness and grade.

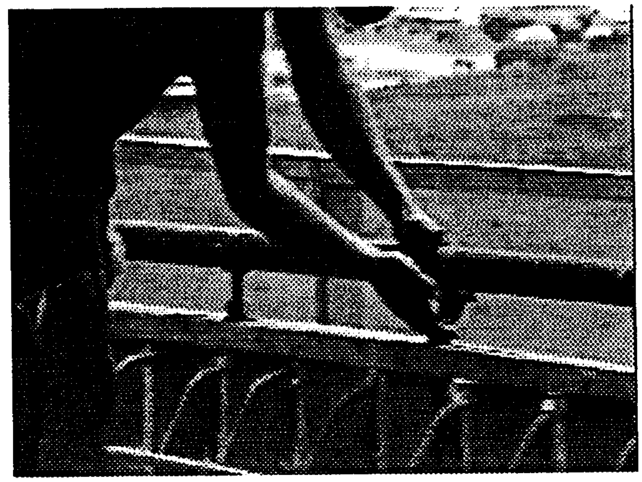
Adjusting the Screed Rails

When the concrete for the deck is placed, the contractor will use a deck finishing machine to strike it off at the correct elevation. Although there are several types of finishing machines, they all have some features in common:

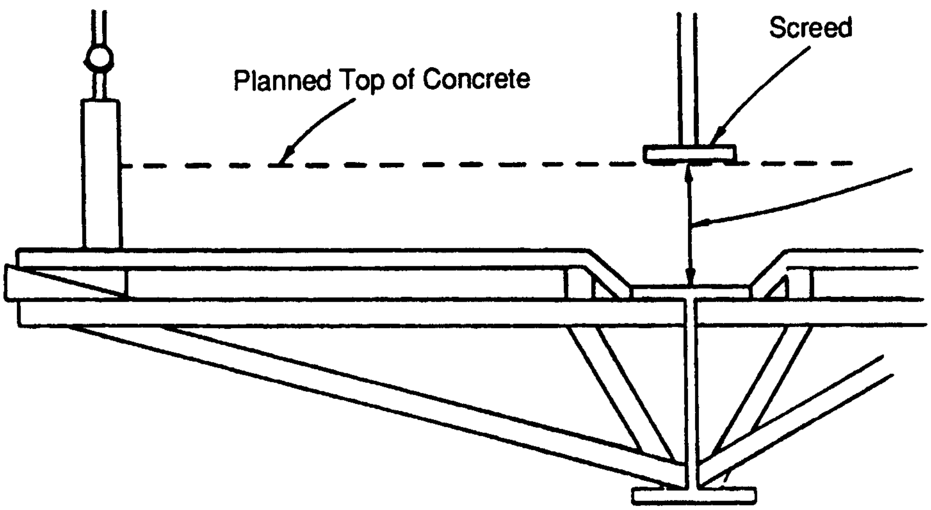
- They ride on tracks, called rails, that are set on top or outside of the forms for the copings or barrier rails.
- They have adjustable screeds that can beset to different crowns and/or elevations. Many finishing machines also have augers that help consolidate the concrete before it's struck off by the screed.
- They have guide tracks from which the screed and auger are suspended.



The contractor must adjust the screed rails so that the screed of the finishing machine will pass over the control points on the beams at the screed elevations shown on the plans. Different contractors will use different methods but all will involve measuring up from the control points and taking into account the rate of cross-slope from one side of the bridge to the other.



After the initial adjustment of the screed rails, the contractor will make several test runs with the finishing machine to check the actual screed elevations above the deck forms and the control points on the beams. The dry run should be conducted back and forth and side to side over the entire bridge. The Certified Technician should take measurements at random from the deck forms up to the screed. The measurements should equal the planned deck thickness at those points.



The amount of concrete cover over the top mat of re-steel should also be checked during the dry run. Measuring up from the top of the re-steel to the screed will indicate the amount of cover. Typical coverage is 2-1/2"; the General Notes section will provide the specific requirements for each structure.

Particular attention should be paid to the elevations of the ends of the bridge and the expansion joints. The screed must strike the concrete off at exactly the same grade as the joints so there will be a smooth transition from the roadway over the joint and onto the deck.

During the trial run, the Certified Technician should watch the screed rails for deflection. The rails should be supported at intervals close enough to prevent sagging which would distort the profile grade.

Concrete Placement

After the adjustments of the screed rails and final checks of the re-steel, the contractor will notify the PE/PS that everything is ready for concrete placement.

Pre-Pour Conference

All project personnel who will be involved with the deck pour should attend the pre-pour conference with the PE/PS and representatives of the contractor. Among the topics to be discussed are (if QC/QA concrete is called out, see the QC/QA Superstructure Concrete section):

- The class of concrete to be used. This is listed on the plans. Most deck concrete will be Class C.
- The slump and air content requirements, including the frequency of field tests.
- The pour sequence. Longer bridges must be poured in sections. The contractor and the technician must know which sections are to be poured first and where to locate the necessary construction joints.
- The quantity of concrete needed. This information is available from the Bill of Materials section on the superstructure details sheets.
- The rate of delivery. It's critical. A slowdown in delivery means the formation of a cold joint -- an area where fresh concrete is poured up against concrete that has begun to set, without the benefit of a construction joint. Steps to install emergency bulkheads should be discussed.
- The weather forecast and what kinds of precautions will be taken against excessive heat, cold, wind, or the threat of rain.
- The contractor's manpower and equipment. Enough skilled workers to produce the required deck thickness and finish. Backup vibrators available. Curing materials on hand

Once all those items have been discussed and resolved, the contractor is ready to begin concrete placement. For the most part, the inspection concerns during the placement of concrete for a bridge deck will be the same as those noted for other parts of the bridge.

Preparation of the Forms

Standing water and construction debris must be removed from all forms before beginning concrete placement. Removable forms that will come into contact with plastic concrete have to be coated with an approved form oil to prevent adhesion.

Concrete Placement and Consolidation

Concrete for decks should be placed as close as possible to the area it will occupy in the structure. It should be placed evenly across the deck from a drop height of no more than five feet.

The concrete must be consolidated with a vibrator as it's placed. Good consolidation techniques include:

- Vertical insertion and withdrawal of the vibrator.
- Insert and withdraw the vibrator quickly to avoid segregation; soupy mix indicates overvibration.

When pouring near expansion joints, make sure that the concrete is placed up under the top plate of the joint. The Certified Technician should be able to see mix coming up through any vent holes on the plate. Tapping the joint with a hammer and listening for hollow sounds that indicate voids is a good practice.

When fresh concrete is placed against a previously poured section at a construction joint, the face of the joint should be coated with an approved epoxy mixture to enhance the bond of the old mix to the new. The type of joint construction, unless it's an emergency bulkhead, will be noted on the plans.

Finishing Operations

The concrete pour should not get too far ahead of the finishing machine; otherwise the mix may begin setting up before it's struck off by the screed. The operator should move the finishing machine ahead only about six inches for every pass across the deck. That ensures striking off every square inch of the surface.

Ideally, the screed will roll a thin bead of concrete directly ahead of it. That usually means that the screed is striking off the mix at the right elevation and filling in low spots as it moves along. If the bead gets too large, however, the screed could lift up over it. Before that happens, the bead should be pulled back with shovels or masonry hoes. Don't allow the use of rakes because they can cause segregation.

As soon as the screed passes, workers may begin applying the initial finish. Typically, this involves brooming, floating, or troweling the surface. This initial finish is done mainly to close the surface and to eliminate bumps and low spots that were left by the screed. The texture of the freshly finished surface should match up closely with that of any previously poured section. Many decks are also tined or grooved mechanically after they've cured.

The deck surface should be checked with a lightweight ten-foot straightedge every two feet transversely and every five feet longitudinally. All high spots must be removed, all depressions must be filled with fresh concrete, and the surface must be leveled by a large float. Floating and manipulating the concrete to fill depressions should be held to a minimum, as should the application of additional water to the concrete in order to lubricate the float surface.

Curing Requirements

Bridge decks are normally cured in the same manner as other structural concrete components and in accordance with Section 702.22, especially 702.22(a), the protective covering curing method. The curing method requiring the use of a curing compound on the deck is rarely used because that prohibits the use of an epoxy surface seal, which protects the deck from salt corrosion.

The typical curing period for decks is from 96 to 120 hours after the concrete has taken its initial set. During that time, the deck must be kept covered with an approved protective covering such as burlap and plastic or burlene and wetted at sufficient intervals to prevent premature drying. That means weekends and holidays, too. One problem area is at the copings where the vertical re-steel extends above the deck concrete. Simply draping the covering over the re-steel or "tenting" the steel isn't adequate; it allows wind to enter and dry the concrete. Instead, the contractor must wind the covering through the steel as well as possible to cover the concrete.

In the rare cases when curing compound is used on a deck, the contractor must be careful not to let the compound come into contact with any exposed reinforcing steel, such as that for copings or barrier rails. Curing compound on the steel would prevent concrete from bonding to the bars.

Finally, walking on a newly poured deck should be discouraged. If walking on the deck is necessary, wood walkways supported by a cushion of burlap should be used.

MIX

The certified technician is the cornerstone of the Quality Assurance Program. Without the certified technician determining the quality and consistency of the concrete being produced, bridge deck performance problems are certain. Although the certified technician ensures quality and consistency, the Contractor has the ultimate responsibility in providing a quality material and quality product. This fundamental shift of quality control from INDOT to the Contractor is important because it places control of the material in the hands of the Contractor.

The advantages of this type of specification include the proper allocation of responsibility for quality between the Contractor and INDOT, more complete records, and statistically based acceptance decisions. The Contractor has a greater choice of materials, and can design the most economical mixtures to meet specifications. Finally, there is a lot-by-lot acceptance so that the Contractor knows if his operations are producing an acceptable product.

It is the responsibility of the certified technician to test the quality and consistency of the concrete being produced. Their job however does not stop at this point. The certified technician must also ensure that the concrete maintains this consistency by monitoring the materials at the plant. Finally, and most important, the certified technician must know what action to take when the materials deviate from specifications.

- **Aggregates**

Aggregates generally occupy approximately 75 percent of the concrete volume and strongly influence the concrete's hardened and freshly mixed properties. The properties of the aggregate have a major effect on the durability, strength, shrinkage, unit weight, and frictional properties of hardened concrete, as well as the mix proportions, slump, workability, pumpability, bleeding, finishing characteristics and air content of freshly mixed concrete. The selection of the proper aggregates and control of the use of those aggregates is essential in producing quality concrete mixtures.

- **Portland Cements**

Portland cements are finely ground powders that set and harden by reacting chemically with water. During this reaction, called hydration, cement combines with water to form a solid mass. When the paste (cement and water) is added to aggregates, it acts as an adhesive and binds the aggregates together to form concrete.

Hydration of the cement begins as soon as there is contact with water. Each cement particle forms a growth on its surface that spreads until it connects with the growth of other particles or adheres to adjacent substances. This reaction results in progressive stiffening, hardening, and strength development. As the concrete stiffens there is a loss of workability that usually occurs within three hours of mixing; however, the composition and fineness of the cement, the mixture proportions, and temperature conditions all may have an affect on the loss of workability.

Hydration will continue as long as there is available space for the hydration products and the moisture and temperature conditions are favorable. The concrete will become stronger as the hydration continues. Most of the hydration and strength development will take place within the first month after mixing, and will continue slowly for a long time.

QC/QA superstructure concrete allows the use of only Portland Cement (Types I, II or III), Portland Blast-Furnace Slag Cement (Type IS), or Portland-Pozzolan Cement (Type IP). Further restrictions on the use of portland cement include:

- **Admixtures**

Admixtures are those ingredients added to concrete immediately before or during mixing other than portland cement, water, and aggregates. The major reasons for using admixtures include:

1. To reduce the cost of concrete construction
2. To achieve certain properties in concrete more effectively than by other means
3. To insure the quality of concrete during the stages of mixing, transporting, placing, and curing in adverse weather conditions

The effectiveness of any admixture is dependent on such factors as:

1. Type, brand, and amount of cement
2. Water content
3. Aggregate shape, gradation, and proportions
4. Mixing time
5. Slump
6. Temperatures of the concrete and air

- **Mix Design**

The concrete mix design (CMD) for QC/QA superstructure concrete must produce a workable concrete mixture having properties that will not exceed the maximum and/or minimum values defined in the special provision. Workability in concrete defines its capacity to be placed, consolidated, and finished without harmful segregation or bleeding. Workability is affected by aggregate gradation, particle shape, proportioning of aggregate, amount and qualities of cementitious materials, presence of entrained air, amount and quality of high range water reducer, and consistency of mixture.

Consistency of the concrete mixture is its relative mobility and is measured in terms of slump. The higher the slump the more mobile the concrete, affecting the ease with which the concrete will flow during placement. Consistency is not synonymous with workability. Two different mix designs may have the same slump; however, their workability may be different.

Selection of target parameters by the contractor for any mix design must consider the influence of the following:

1. material availability and economics
2. variability of each material throughout period of usage

3. control capability of production plant

4. ambient conditions expected at the time(s) of concrete placement

5. of concrete production, delivery, and placement

6. variability in testing concrete properties

7. generation of heat in large structural elements and differential in thermal gradient (i.e. 2 - 3 ft thick and cement content above 600 lb/yd^3)

- **Mixing Proportioning**

Once the cement content, pozzolan content, water/cementitious ratio, and fine to total aggregate percentage are defined for the concrete's intended use in the superstructure, proportioning of the mix in terms of design batch weights can begin. Specific gravities must be accurately defined for each material being utilized in order to proportion the mix properly by the absolute volume method. Cement is typically accepted as having a specific gravity of 3.15. Pozzolans will typically vary between 2.22 and 2.77 depending on the type of pozzolan (fly ash, GGBFS, silica fume) and its source. Pozzolan suppliers should readily be able to provide current values for their material. Approximate specific gravities are identified for each source on the Department's Approved/Prequalified Materials list; however, they should not be considered the most current.

A trial batch demonstration (TBD) is required for each proposed mix design for QC/QA superstructure concrete. The purpose of the TBD is much more than validating the required concrete properties to be within the specification requirements for the concrete mixture. The TBD also provides an opportunity for the Contractor's Certified Concrete Technician and the Departments Qualified Technician to verify proper equipment calibration and testing procedures prior to any concrete placement in the structure. The Contractor and the PE/PS should both be assured that QC testing will accurately represent the concrete for any process control decision and acceptance testing will assess the proper adjustment points, if any. Failure to accomplish this at the TBD can result in inaccurate assessment of adjustment points or erroneous failed material investigations when job concrete is placed

The results from a successful TBD can provide the Contractor with baseline properties from which to plan process control of the concrete mixture. Future changes in properties of aggregates, pozzolans, cements, and admixtures can also be compared to the results at the time of the TBD so effects on concrete properties the day of placement can be anticipated.

The TBD also provides an opportunity for the Contractor and Engineer to witness the process upstream from the plant (i.e. material receipt, storage, and handling), through batching and actual concrete production. The complete process should be inspected to provide insight as to any potential process control problems prior to job placement. A properly conducted TBD can work to resolve many problems, which would otherwise become evident on the day of the deck's construction

QUALITY ASSURANCE SPECIFICATIONS

- **Sublots and Lots**

Quality Assurance specifications consider a sublot as typically 50 yd^3 as measured against the plan quantity for each mix design of superstructure concrete. A partial sublot of 15 yd^3 or less will be considered as part of the previous sublot and a partial sublot greater than 15 yd^3 will be considered an individual sublot.

A lot will typically consist of three sublots or 150 yd^3 of planned quantity of superstructure concrete for each mix design. If there is only one sublot in an incomplete lot then the sublot will be included in the previous lot. If there are two sublots in an incomplete lot then the quantity of material will be considered a lot. Therefore, a lot may contain two, three or four sublots.

If the superstructure concrete is placed at several locations on one contract, such as one bridge to another bridge or one phase to another phase, then the sublots will be determined in the order that the material was placed.

- **Random Sampling**

Sampling of material for acceptance testing is done by INDOT on a random basis using ITM 802. A random cubic yard of superstructure concrete within a sublot is determined and the location on the bridge deck of the random quantity is established. The random locations are not given to the Contractor so that there will be no possible influence on the production operations.

- **Air Content and Unit Weight**

The frequency of tests for the air content and unit weight is one series for each sample for each sublot. The air content will be determined in accordance with AASHTO T 152 when stone or gravel coarse aggregate is used in the concrete and AASHTO T 196 when slag coarse aggregate is used. The concrete material used to obtain the unit weight may be used to conduct the air content test.

- **Compressive Strength**

The frequency of tests for the compressive strength will be one set of two cylinders for each sublot. The two cylinders will be tested at 28 days in accordance with AASHTO T 22 and the test values averaged to determine the sublot compressive strength. The Contractor is required to provide sufficient saturated limewater filled containers at the work site for initial curing of compressive strength specimens. The cylinders are completely submerged in the saturated limewater at a temperature of 60 to 80°F for no less than 16 nor more than 48 hours. After the initial curing the cylinders are transported to an INDOT laboratory within 4 hours for additional curing, capping, and testing.

- **Slump**

The slump of the concrete is visually estimated during production. If it is suspected that the slump is not within the allowable limits at the point of placement, the Contractor will be informed. The truck in question shall discontinue placement in the structure until a slump test is conducted to verify compliance. If the slump is outside compliance, the Contractor shall test the concrete for air content and unit weight. The truck shall not continue placement in the structure until quality control test results substantiate compliance.

- **Adjustment Points**

Adjustment points are assessed for air content, compressive strength at 28 days, and the range of air content. The range of air content is defined as the difference between the highest test value and the lowest test value for air content within a lot.

The averages for the lot are compared to the acceptance tolerances designated in the specifications for each property. If the tolerances are not met, adjustment points are assigned for each property in accordance with the specifications. The adjustment for each property is calculated as follows where L is the quantity of the Lot, U is the price of the item, and P is equal to the adjustment points:

$q_{ai} = L_i \times Um \times P_{ai}/100$ air content in each individual lot
$q_{ri} = L_i \times Um \times P_{ri}/100$ air content range in lot
$q_{ci} = L_i \times Um \times P_{ci}/100$ compressive strength in lot

The total quality assurance adjustment will be calculated as follows:

$$Q = \Sigma (q_{ai} + q_{ri} + q_{ci})$$

For lots i=1 to n

Q = total quality assurance adjustment
i = individual lot
n = last lot

- **Appeals and Failed Materials**

If the Contractor does not agree with the acceptance test results that is received from the PE/PS in writing displaying the unacceptable lot of QC/QA superstructure concrete, an appeal may be submitted. The appeal shall satisfy the following criteria:

1. Appeals shall be submitted in writing to the PE/PS within five calendar days of receipt of INDOT's written results for the lot.

2. The submission shall contain quality control test data that equals or exceeds the number of tests required.

3. The difference between the acceptance test result and the nearest quality control test result shall be at least 0.5 percent for air content.

4. The difference between the acceptance test result and the nearest quality control test result shall be at least 100 psi for compressive strength at 28-days.

If the Failed Materials Committee approves the appeal then the Engineer will dictate the location that shall be obtained by the Contractor at the location that most closely approximates the appropriate sublot acceptance sample location. The coring shall be completed within 30 days of acceptance of the appeal unless traffic restrictions prevent the coring and at the Contractors expense. Cores shall be 3.75 or 4.00 inches in diameter and the Contractor shall fill all core holes with concrete within 24 hours of drilling.

Sublot and lot values that are excessively out of tolerance are required to be submitted to INDOT for final adjudication. As a minimum the Failed Materials Committee will consider no additional payment

adjustment, an increased payment adjustment to offset potential maintenance costs, additional payment to cover the cost of the investigation, no payment, or removal and replacement.
6-16

- **Quality Control Plan**

The foundation for a successful Quality Assurance program is the control maintained by the Contractor to assure that all materials submitted for acceptance conform to the contract requirements. To accomplish this it is imperative that the Contractor have a functional Quality Control Plan (QCP) to keep the process in control, quickly determine when the process goes out of control, and respond adequately to bring the process back into control. (QCP must comply with requirements that are given in the appendix on pg.-----)

The QCP is required to be submitted to the PE/PS for review at least 15 calendar days prior to commencing concrete operations. The Contractor shall sign and date the QCP at the time it is submitted to the PE/PS. The PE/PS will sign and date the QCP if the contents of the QCP are in compliance with the above-noted requirements. Concrete operations shall not begin before the QCP has been accepted and a successful trial batch demonstration completed. Concrete mix designs and trial batch demonstrations may be submitted for approval prior to the submittal of the QCP.

The QCP shall be maintained to reflect the current status of the operations, and revisions are required to be provided in writing prior to initiating the change. The change shall not be implemented until the revision has been accepted; however, traffic patterns for delivery of the concrete mix to the site of work may be adjusted for unanticipated conditions without an addendum to the QCP.